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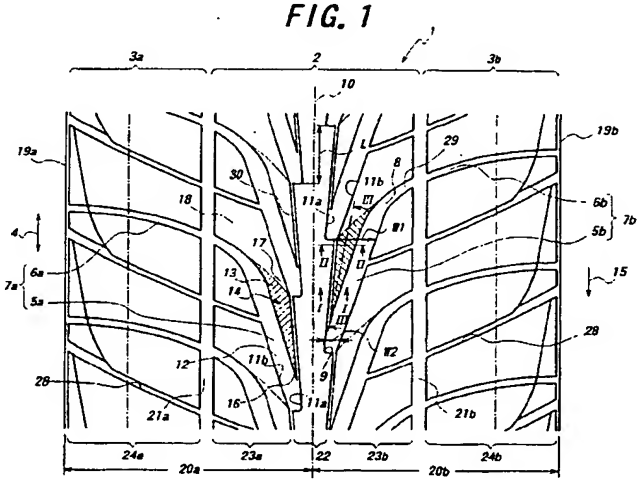
(54) Pneumatic tires

(57) A pneumatic tire comprises a tread portion (1) having a plurality of slant grooves (7a,7b), in which each slant groove has a steeply slant groove portion (5a,5b) and a gently slant groove portion (6a,6b), and the steeply slant groove portion comprises a pseudo-land part (14) of a given shape, and can improve the drainage performance without sacrificing the other tire performances. Such a tire is in particular characterized in that an opening groove width (W1) located at the end (8) of the steeply slant groove portion (5a,5b) which is close to a tread end is wider than an opening groove width (W2) located at the end (9) of the steeply slant groove portion which is close to the tire equatorial plane, and the steeply slant groove portion extending in a longitudinal direction of the slant groove (7a,7b) comprises a groove edge part (31) forming a boundary to an outer surface (33) of a tread land portion, a main groove bottom part (32) mainly forming a groove bottom of the steeply slant groove portion, and a pseudo-land part (14) located in the groove edge part (31) and adjacent to at least one of both side edges (32a,32b) of the main groove bottom part (32), and the pseudo-land part (14) has such a slant surface (13) that a height thereof is gradually decreased from the groove edge part (31) toward the main groove bottom part (32).

FIG. 1



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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 01 30 8626

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		EP 1075971 A1	14-02-2001
		WO 0051831 A1	08-09-2000
JP 10016515 A	20-01-1998	NONE	

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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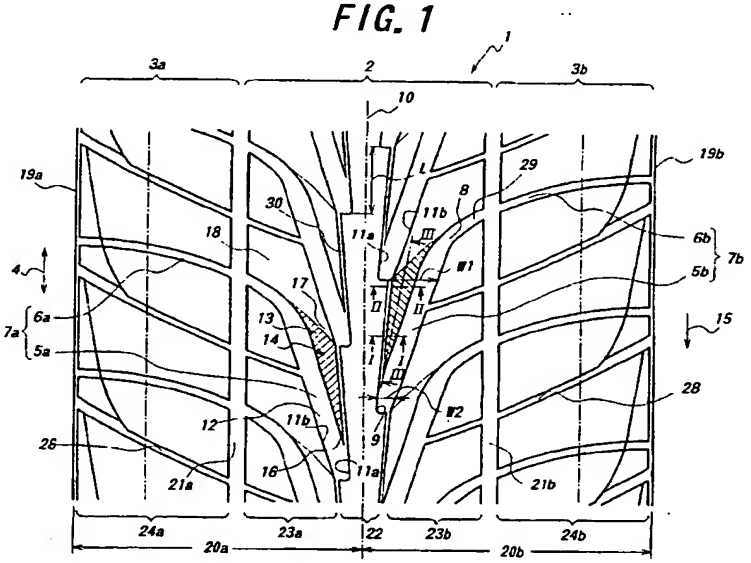
FIG. 1



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preferable to have substantially a triangular or trapezoidal and flat or curved surface shape when viewing the tire from a front thereof.

[0011] Furthermore, when it is required to reduce a pattern noise, a pair of adjoining slant grooves located on both sides of a pattern center are preferable to be formed at a phase difference of a half pitch in the circumferential direction of the tire.

[0012] Moreover, when the drainage performance is particularly attached importance, it is preferable to arrange one circumferential main groove extending along the circumferential direction of the tire in a widthwise central position of each half tread zone sandwiched between the pattern center and both the tread ends or in the vicinity of the central position of the half tread zone.

[0013] In addition, when sufficient drainage performance and steering stability are balancedly satisfied, it is preferable to form at least one rib-shaped land portion extending along the circumferential direction of the tire and at least two land rows each comprised of plural blocks in the tread portion.

[0014] In case of mainly aiming at the improvement of the drainage performance, the pseudo-land part is preferable to be arranged adjacent to a side edge of the main groove bottom part located at the pattern-center-side of the main groove bottom part in the steeply slant groove portion. If it is required to compensate for the rigidity of both land portions divided by the steeply slant groove portion, the pseudo-land parts are preferable to be separately arranged adjacent to both side edges of the main groove bottom part in the steeply slant groove portion.

[0015] The invention will be described with reference to the accompanying drawings, wherein:

FIG. 1 is a partly developed view of a tread portion in an embodiment of the pneumatic tire according to the invention;
FIG. 2A is a diagrammatically section view of a pseudo-land portion taken along a line I-I of FIG. 1;
FIG. 2B is a diagrammatically section view of the pseudo-land portion taken along a line II-II of FIG. 1;
FIG. 2C is a diagrammatically section view of the pseudo-land portion taken along a line III-III of FIG. 1;
FIG. 3 is a partly developed view of a tread portion in another embodiment of the pneumatic tire according to the invention;
FIG. 4A is a diagrammatically section view of a pseudo-land portion taken along a line I-I of FIG. 3;
FIG. 4B is a diagrammatically section view of the pseudo-land portion taken along a line II-II of FIG. 3;
FIG. 4C is a diagrammatically section view of the pseudo-land portion taken along a line III-III of FIG. 3;
FIG. 4D is a diagrammatically section view of the pseudo-land portion taken along a line IV-IV of FIG. 3; and
FIG. 5 is a partly developed view of a tread portion in the conventional pneumatic tire.

[0016] In FIG. 1 is partly shown a tread pattern formed on a tread portion in an embodiment of the pneumatic tire according to the invention, in which numeral 1 is a tread portion, numeral 2 a central region, numerals 3a and 3b side regions, numeral 4 a circumferential direction of the tire, numerals 5a and 5b steeply slant groove portions, numerals 6a and 6b gently slant groove portions, and numerals 7a and 7b slant grooves.

[0017] When the tread portion 1 of the tire shown in FIG. 1 is divided into the central region 2 and both side regions 3a, 3b, the tread portion 1 is provided with a plurality of slant grooves 7a, 7b comprising the steeply slant groove portions 5a, 5b located in the central region 2 and extending slantly at a relatively small angle, preferably an angle of no more than 30° with respect to the circumferential direction 4 of the tire, and the gently slant groove portions 6a, 6b located in the side region 3a, 3b and extending slantly at a relatively large angle, preferably an angle of 70-85° with respect to the circumferential direction 4 of the tire.

[0018] In the invention, an extending direction of the steeply slant groove portion 5a, 5b arranged in the central region 2 is constructed so as to substantially coincide with a flowing direction of water in the central region of the tread in the tire contacting with ground to thereby ensure the drainage performance, while the corner portions of the lands defined by the gently slant groove portions 6a, 6b arranged in the side regions 3a, 3b become obtuse to ensure the rigidity of the land, so that a good steering stability can be obtained.

[0019] However, the inventor has examined a possibility of further improving the drainage property with respect to the above tread pattern and obtained the following knowledge.

[0020] That is, it has been confirmed that when water existing in the central region of the tire contacting with ground is taken into the steeply slant groove portions 5a, 5b of the slant grooves 7a, 7b and moved to the gently slant groove portions 6a, 6b to discharge therefrom toward the lateral direction of the tire, if the groove width of the steeply slant groove portion 5a, 5b is made wider, water is easily taken into the steeply slant groove portion 5a, 5b, but the rigidity of the land becomes insufficient, and also water taken into the slant groove 7a, 7b collides with a groove wall of a curved groove portion 29 located between the steeply slant groove portion 5a, 5b and the gently slant groove portion 6a, 6b to easily cause the disturbance in the flowing of water, which largely lowers the drainage ability of the slant grooves 7a, 7b toward the lateral direction of the tire.

[0021] To this end, the inventor has made various studies in order to easily take water existing the central region of the tire contacting with ground into the steeply slant groove portions 5a, 5b without almost lowering the rigidity of the

[0033] When it is required to more enhance the drainage performance, it is preferable to arrange a width-narrow circumferential sub-groove (not shown) extending along the circumferential direction 4 of the tire between the pattern center 10 and the circumferential main groove 21a, 21b. In case of arranging the circumferential sub-groove, in order to avoid the wandering such as rain groove or the like, it is favorable that when viewing the inside of the circumferential sub-groove toward the extending direction in the developed view of the whole of the tread portion constituting the tire, the sub-groove is constituted so as to have a groove shape that can not see through the whole of the inside of the sub-groove.

[0034] Although the above is described with respect to only a preferred embodiment of the invention, various modifications may be taken within a scope of the invention.

[0035] For example, as shown in FIG. 1, in order to more improve the drainage performance, an auxiliary groove 28 may be arranged between the gently slant groove portions 6a, 6a or 6b, 6b of the slant grooves 7a, 7a or 7b, 7b which are adjacent to each other in the circumferential direction 4 of the tire so as to extend from the groove wall located at the tread-end-side of the steeply slant groove portion in the slant groove and at the final ground contact side during the rotation of the tire in the arrow direction 15 through the circumferential main groove 21a, 21b up to open in the tread end 19a, 19b.

[0036] And also, it is favorable that a curved groove part 29 having a smooth curvature of connecting the steeply slant groove portion 5a, 5b to the gently slant groove portion 6a, 6b is formed in the slant groove 7a, 7b at a position ranging from the circumferential main groove 21a, 21b toward the pattern center 10 in view of the maintenance of the land rigidity, the prevention of the heel and toe wear in the land located in the side region 3a, 3b and the maintenance of the drainage performance toward the lateral direction of the tire.

[0037] Furthermore, the slant surface 13 of the pseudo-land part 14 may be inclined from a position of the height of the groove wall of the steeply slant groove portion 5a, 5b toward the groove bottom 12 as shown in FIGS. 4A-4D, or may be inclined from a position located inward from the above position of the groove wall height in the radial direction of the tire toward the groove bottom 12.

[0038] The following examples are given in illustration of the invention and are not intended as limitations thereof.

Example 1

[0039] A tire of this example is a pneumatic tire having a tread pattern shown in FIG. 1 and a tire size of PSR 205/55R16 (tread width: 170 mm), in which dimensions of circumferential main grooves, slant grooves and the like are shown in Table 1. Moreover, the structure other than the tread portion of the tire is substantially the same as that of the conventional pneumatic tire usually used in a passenger car.

Table 1

	Groove width (mm)	Groove depth (mm)	Groove angle* 1(°)
Circumferential main groove 21a, 21b	7	8	0
Steeply slant groove portion 5a, 5b	10		5 - 25
Gently slant groove portion 6a, 6b	4	6.5	70 - 80
Auxiliary groove 28	2	6.5	70 - 65
Curved part 29	6	8 - 6.5	25 - 70
Pseudo-land part 14	Width of land: 8 - 0 mm, Length of land: 45 - 70 mm, Height of land: 8 - 0 mm		

* 1: Angle with respect to the circumferential direction of tire

Example 2

[0040] A tire of this example is a pneumatic tire having a tread pattern shown in FIG. 3 and a tire size of PSR 205/55R16 (tread width: 170 mm), in which dimensions of circumferential main grooves, slant grooves and the like are shown in Table 2. Moreover, the structure other than the tread portion of the tire is substantially the same as that of the conventional pneumatic tire usually used in a passenger car.

Table 4

		Conventional Example	Example 1	Example 2
Evaluation of performances	Drainage performance *1	100	110	115
	Drainage performance *2	100	105	110
	Steering stability *3	100	105	100
	Pattern noise	100	110	105

*1: During straight running
*2: During cornering
*3: During running on dry road surface

[0050] As is seen from the results of Table 4, Examples 1 and 2 are excellent in the drainage performance and steering stability as compared with those of the conventional example and reduce the pattern noise.

[0051] According to the invention, there can be provided pneumatic tires, particularly high-performance tires improving the drainage performance without sacrificing the other tire performances such as steering stability and the like.

Claims

1. A pneumatic tire comprising a tread portion (1) with a tread pattern defined by a plurality of slant grooves (7a,7b), each of said slant grooves comprising a steeply slant groove portion (5a,5b) located in a widthwise central region (2) of the tread portion, said steeply slant groove portion being inclined at a relatively small angle with respect to a circumferential direction (4) of the tire, and one end (9) of the steeply slant groove portion which is close to an equatorial plane of the tire extending toward the other end (8) of the steeply slant groove portion which is close to a tread end, and a gently slant groove portion (6a,6b) located in a side region (3a,3b) of the tread portion, said gently slant groove portion being inclined at a relatively large angle with respect to the circumferential direction of the tire, and said gently slant groove portion extending from the end (8) of the steeply slant groove portion or an extension thereof so as to open at the tread end (19a,19b), **characterized in that** an opening groove width (W1) located at said other end (8) of the steeply slant groove portion (5a,5b) is wider than an opening groove width (W2) located at said one end (9) of the steeply slant groove portion, and the steeply slant groove portion extending in a longitudinal direction of the slant groove (7a,7b) comprises a groove edge part (31) forming a boundary to an outer surface (33) of a tread land portion, a main groove bottom part (32) mainly forming a groove bottom of the steeply slant groove portion, and a pseudo-land part (14) located in the groove edge part (31) and adjacent to at least one of both side edges (32a,32b) of the main groove bottom part (32), and the pseudo-land part (14) has such a slant surface (13) that a height thereof is gradually decreased from the groove edge part (31) toward the main groove bottom part (32).

2. A pneumatic tire as claimed in claim 1, **characterized in that** the steeply slant groove portion (5a,5b) of the slant groove (7a,7b) extends at an angle of not more than 30° with respect to the circumferential direction (4) of the tire.

3. A pneumatic tire as claimed in claim 1 or 2, **characterized in that** the slant surface (13) of the pseudo-land part (14) has substantially a triangular shape or a trapezoidal shape when viewing the tire from the front thereof.

4. A pneumatic tire as claimed in any of claims 1 to 3, **characterized in that** a pair of adjoining slant grooves (7a, 7b) located on both sides of a pattern center (10) are formed at a phase difference (L) of a half pitch in the circumferential direction (4) of the tire.

5. A pneumatic tire as claimed in any of claims 1 to 4, **characterized in that** one circumferential main groove (21a, 21b) extending along the circumferential direction (4) of the tire is arranged at a widthwise center position of each tread half region (20a,20b) defined between the pattern center (10) and the tread end (19a,19b) or arranged in the vicinity of the widthwise center position of the tread half region.

6. A pneumatic tire as claimed in any of claims 1 to 5, **characterized in that** the gently slant groove portion (6a,6b) of the slant groove (7a,7b) extends at an angle of 70-85° with respect to the circumferential direction (4) of the tire.

FIG. 1

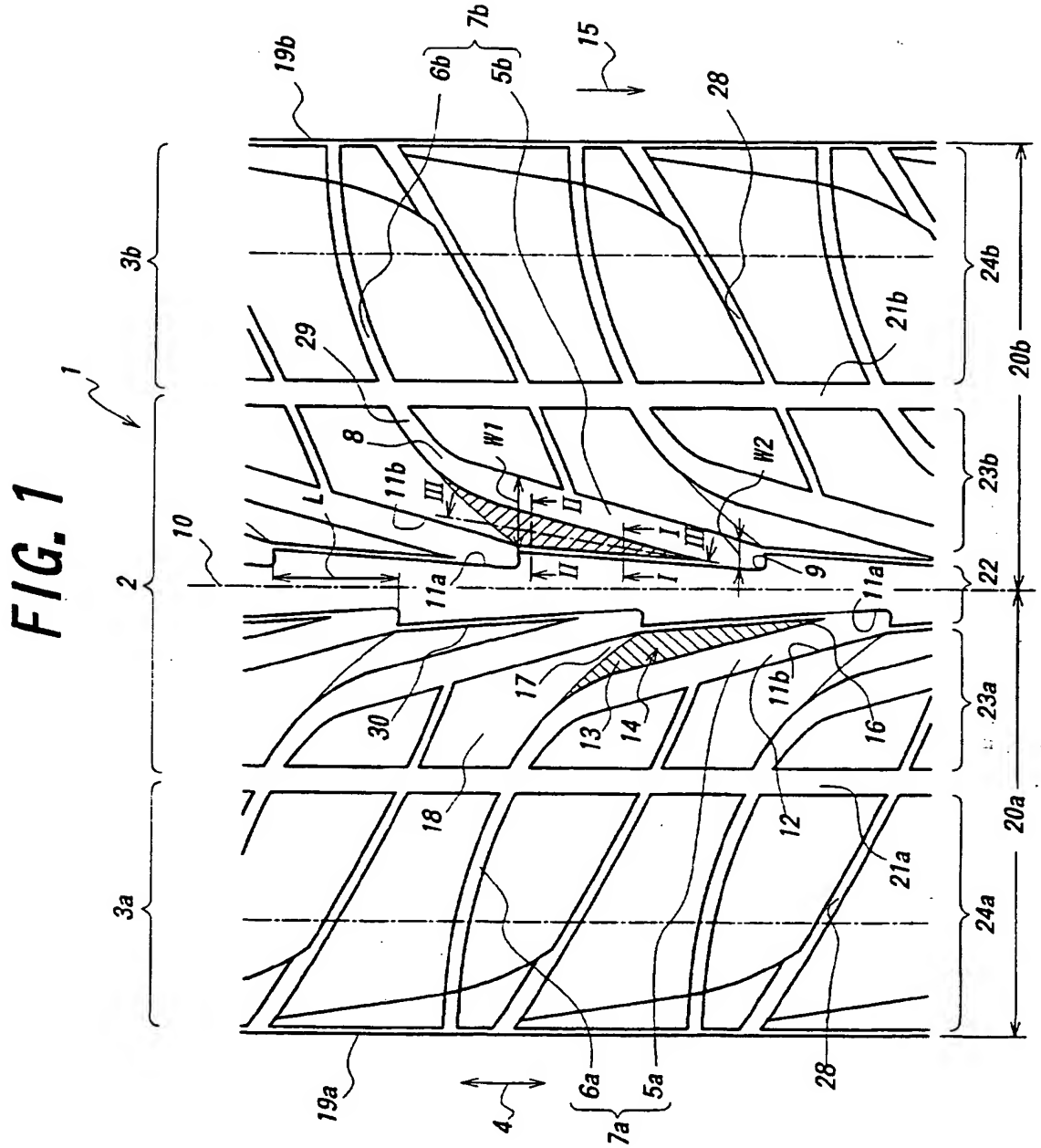

FIG. 3

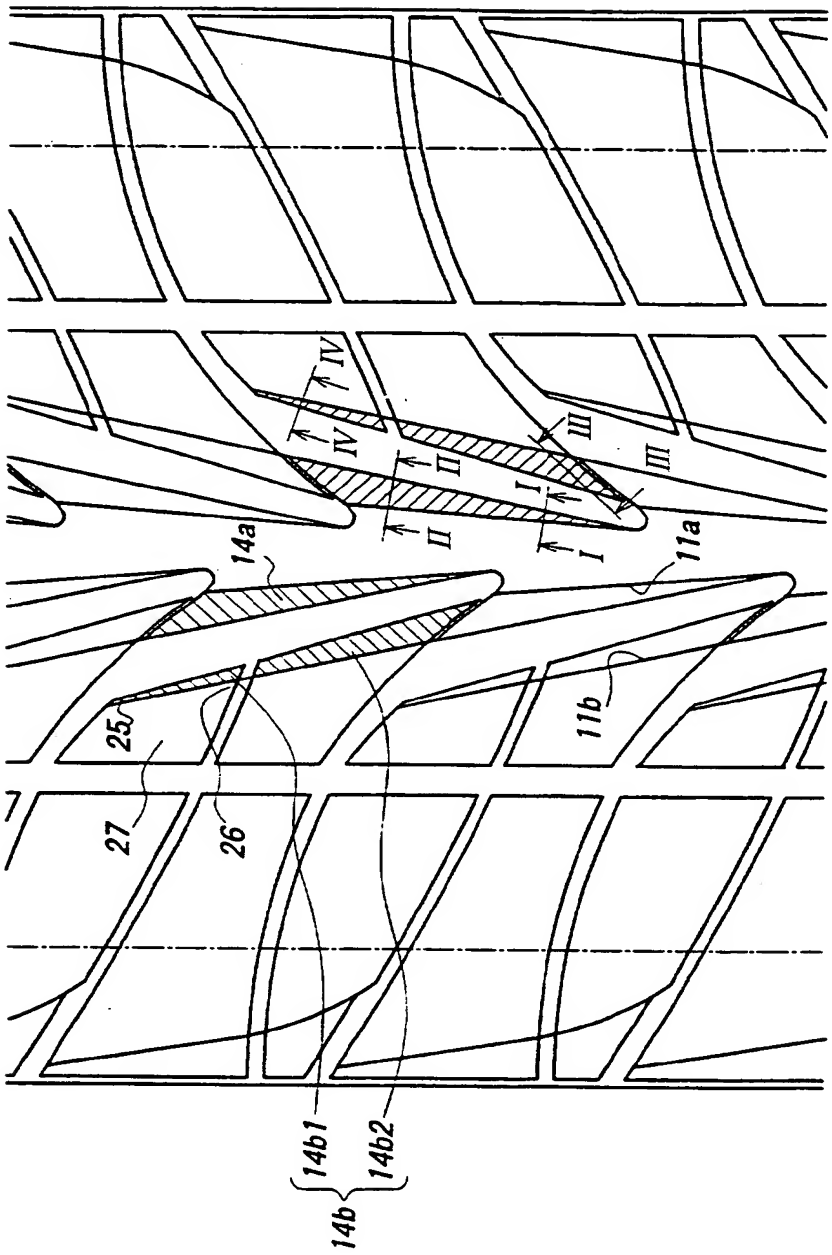

FIG. 5
PRIOR ART